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Method for washing pulp in e bleaching line.

The present invention relates to a method of bleaching cellulose pulp and a bleach line for the method.

PRIOR ART

It is a desire in multi-stage bleaching of cellulose pulp to reduce the water requirement and the quantity of outlet contaminated process water, which contaminated process water is either pumped to sewage, possibly via sedimentation basins and/or to costly destruction/deposition.

With the object of reducing the liquor quantities, the bleaching department is ever more closed and most often the process water is lead in counter-current to the direction of flow of the cellulose pulp in the process steps of the bleaching line. Accordingly, the fresh water or the clean process water is used in the wash of the last step and the wash filtrate obtained there from is led as wash liquor to the wash of the preceding step and further up through the bleaching line.

Commonly, a number of filtrate tanks are used between each bleaching step wash for this leading of wash filtrate through the process, with the object of guaranteeing supply of wash liquor and securing that the wash liquor is lead in counter-current to the flow of cellulose pulp.

In addition to such filtrate tanks, expensive control and regulation systems with valves are required for this handling of the wash liquor in filtrate tanks, to monitor the levels in the filtrate tanks since the risk can not be taken that a filtrate tank is emptied whereby it may cause a stoppage in the wash of the bleaching step in question.

The number or filtrate tanks also results in a risk of an increased outlet of odorous gases as all filtrate tanks require ventilation in order to level out changes in the volume in the filtrate tanks. Often, special degassing systems are required to handle and destruct such odorous gases.

Accordingly, big advantages could be attained if the number of filtrate tanks between the process steps could be minimised.

THE OBJECT AND PURPOSE OF THE INVENTION

One object of the invention is to reduce the need of, and in some cases completely eliminate, such expensive filtrate tanks, control systems and valves in the wash liquor systems, whereby the investment costs for the bleaching line may be strongly reduced. The reduced number of necessary filtrate tanks also results in the possibility of a more

compact and more optimal design of the bleaching line, without consideration of such filtrate tanks that conventionally numbers to at least the same number as the number of bleaching steps, with a more efficient layout of the bleaching steps of the bleaching line.

Yet another object is to increase the runnability/accessability of the system as several control valves may be removed, that otherwise are always potential risks for plugging/stoppage of the liquor distribution system.

Yet another object is to improve the runnability as the risk of mixing-in of air in the filtrate system is considerably reduced when the number of filtrate tanks can be considerably reduced. At the same time, accumulation of floating pulp is avoided, which floating pulp usually accumulates after a certain running time, by surface flotation in filtrate tanks. Principally in alkaline steps, such accumulated floating pulp may rise to a level of a few metres above the surface in the filtrate tanks and it must be continuously taken care of or recycled to the bleaching line in order not to risk plugging of the filtrate systems.

Yet another object is that the bleaching plant can be rendered more environmentally friendly as occasional overloads in certain positions, so called over-runs, need not result in outlet of gas or liquor.
Yet another object is to minimise the water consumption.
By the system, the system itself may compensate for occasional changes in wash liquor requirements in the various bleaching steps and secure that a required wash liquor quantity is always guaranteed the bleaching steps.

It is yet another object to minimise the energy consumption in pumps in the filtrate distribution system, where instead a pressurised filtrate main conduit is maintained and any required liquor quantity is drawn off form the main conduit, as needed.

Yet another object is to decrease the length of the tube system, which reduces the costs of installation and the complexity of the system, whereby in the latter case the lucidity is also increased for the operators.

A cost reduction of between 1 and 2 millions USD can be obtained for a 4-step bleaching line D_0-EOP-D_1-D_2 with intermediate wash steps, if the invention is fully applied.

LIST OF DRAWINGS

Fig. 1 shows a conventional prior art bleaching sequence D_0-EOP-D_1-D_2 in which the filtrate is led in counter-current, via filtrate tanks;

Fig. 2 shows the same bleaching sequence D0-EOP-D1-D2 in which the filtrate is lead between the steps in accordance with the invention, according to an embodiment using a high pressure mode,

Fig. 3 shows a part of the bleaching sequence as also shown in Fig. 2, but according to another embodiment of the invention where a low pressure mode is used, and,

Fig. 4 shows a section of a further embodiment according to any of the bleaching sequences according to Fig. 2 or Fig. 3, wherein minor modifications have been performed.

PRIOR ART

Fig. 1 shows a conventional bleaching sequence D_0-EOP-D_1-D_2 in which the filtrate from the washing between the steps is led in counter-current between the bleaching steps, via filtrate tanks FT_1-FT_4.

The pulp is pumped by a pump from a first storage tower, to a first wash W_1 in which the pulp is washed with a clean first filtrate FF1. In the figure, wash apparatuses of wash press type are schematically shown, having two contra-rotating wash drums where wash liquor is supplied to the web of pulp on both drums, but subsequently the figure only shows the supply of wash liquor to one drum of the wash press.

It is typical to such bleaching systems having wash presses that the bleaching takes place in reactors at a pulp consistency of 10-14 % and that after treatment in the reactor, the pulp is diluted to about 5-10 %, typically about 8 %, before it is fed to the wash press. After the wash press, the pulp has a consistency of 20-35 %, typically 30 %.

After the first wash W_1, the washed pulp is fed down into a chute in which the pulp is diluted by a liquor that is pumped from a filtrate tank FT_1, from which chute it is pumped by a pump and a subsequent mixer M1 to a subsequent bleaching step, here a first chlorine dioxide step D_0 shown as an up-flow tower (the pulp flows upwards in the tower). The chemicals for the bleaching step, ClO_2 and acidifier H_2SO_4, are mixed-in by the mixer M1 before the pulp is led to the D_0 bleaching tower.

After the bleaching in the D_0 bleaching tower, the pulp is led to a chute in which the pulp is diluted by filtrate from the first filtrate tank FT_1. From the chute, the pulp is pumped to a subsequent wash W_2 in which the pulp is washed by wash liquor from a third filtrate tank FT_3.

Thereafter, the pulp washed in the wash W_2 is led to a chute in which the pulp is diluted by filtrate from a second filtrate tank FT_2, and from the chute the pulp is pumped by a

pump and a subsequent mixer M2 to a subsequent alkaline extraction step, here an EOP step shown as an up-flow tower. The chemicals for the extraction step, NaOH and peroxide H_2O_2, and oxygen gas if needed, are mixed in by the mixer M2 before the pulp is led to the EOP tower.

After the treatment in the extraction tower EOP, the pulp is led to a chute in which the pulp is diluted by filtrate from the second filtrate tank FT_2, where after the pulp is pumped to a subsequent wash W_3. In the wash W_3, the pulp is washed by clean filtrate FF2.

After the wash W_3, the washed pulp is fed down to a chute in which the pulp is diluted by filtrate from a third filtrate tank FT_3, where after the pulp is pumped by a pump and a subsequent mixer to a subsequent bleaching step, here a second chlorine dioxide step D_1, shown as an up-flow tower. The chemicals for the D_1 bleaching step, ClO_2 and pH-adjuster, are mixed in by the mixer before the pulp is led to the D_1 bleaching tower. As an alternative, the adjusting of pH can take place by addition of e.g. NaOH in the preceding chute.

After the treatment in the D_1 bleaching tower, the pulp is led to a chute in which the pulp is diluted by filtrate from the third filtrate tank FT_3, where after the pulp is pumped to a subsequent wash W_4. In the wash W_4, the pulp is washed by filtrate from a fourth filtrate tank FT_4.

After the wash W_4, the washed pulp is fed down to a chute in which the pulp is diluted by filtrate from a fourth filtrate tank FT_4, where after the pulp is pumped by a pump and a subsequent mixer to a subsequent bleaching step, here a third chlorine dioxide step D_2, shown as an up-flow tower. The chemicals for the D_2 bleaching step, ClO_2 and pH-adjuster, are mixed in by the mixer before the pulp is led to the D_2 bleaching tower. As an alternative, the adjusting of pH can take place by addition of e.g. NaOH in the preceding chute.

After the treatment in the D_2 bleaching tower, the pulp is led to a chute in which the pulp is diluted by filtrate from the fourth filtrate tank FT_4, where after the pulp is pumped to a subsequent wash W_5. In the wash W_5, the pulp is washed by clean filtrate FF3.

The pulp bleached by the shown bleaching sequence, D_0-EOP-D_1-D_2, is subsequently led to a storage tower (not shown) and typically has a brightness above ISO 80 and is often a fully bleached pulp of ISO 90. In certain cases, a subsequent treatment can be used to modify the properties of the pulp in respect of drainage properties etc.

The main principle of the filtrate distribution of the shown bleaching sequence is that there are filtrate tanks between the treatment steps, which filtrate tanks receive the filtrate from the wash in question.

The filtrate tank FT_4 of the last wash W_5 collects the filtrate and then the filtrate is led in counter-current to the flow of pulp through the bleaching line, via pumps, and is used as dilution or wash liquor in preceding positions. In a corresponding manner, filtrate from the wash apparatuses W_4, W_3, W_2 is collected in the filtrate tanks FT_3, FT_2 and FT_1, respectively, and then the filtrate is led via pumps, from the respective tank in counter-current to the flow of pulp through the bleaching line.
In certain circulations, a certain share of the filtrate is also bled off, as is shown in the feed from the filtrate tanks FT_1 and FT_2, in order to avoid accumulation of increasing contents of undesired substances, which bleeding-off is compensated by supply of cleaner filtrates FF1 and FF2. The bleeding-off of filtrate is the principle outlet from the bleaching line. In this counter-current filtrate distribution, alkaline filtrate is separated from acidic. Accordingly, the alkaline filtrate from the EOP step is collected in the filtrate tank FT_2, and no acidic filtrate is used in the wash W_3, but instead clean filtrate FF2 is used. In certain applications, such alkaline filtrate can be fed on, upstream, to the oxygen delignification, where it is used as wash liquor in the wash after the oxygen delignification.
For the acidic filtrates that are collected in the filtrate tanks FT_4, FT_3 and FT_1, the wash liquor is led strictly counter-current to the flow of pulp, i.e. from FT_4 to FT_3, and finally to FT_1 from where the acidic filtrate is bled off from the bleaching department since it can not be handled in the recovery system, mainly due to high contents of chloride that destroy the soda recovery boiler.

PREFERRED EMBODIMENT OF THE INVENTION

Fig. 2 shows an embodiment of the invention, in which the same bleaching sequence is performed as described/shown in relation to Fig. 1, but in which the filtrate distribution system instead of the large number of filtrate tanks, has been replaced by a joint main conduit 1 for all acidic bleaching steps, in accordance with the invention.

Accordingly it is understood that according to the invention bleaching of the cellulose pulp takes place in a bleaching line with at least two bleaching steps in the bleaching line and at some point including a first and a second bleaching step D_1, D_2 in succession, as seen in the flow direction of the cellulose pulp, which bleaching steps have wash apparatuses W_4 and W_5 for the pulp arranged after the first and the second bleaching step, respectively. As shown in Fig. 2, wash liquor and dilution liquor, is led in principle in counter-current to the flow of pulp via the main conduit 1 and through the bleaching steps of the bleaching line, which flow of pulp (bold arrows are flow lines) passes through the sequence W_1-D_0-W_2-EOP-W_3-D_1-W_4-D_2-W_5.

The wash liquor is supplied to the main conduit 1 that is arranged in parallel to the bleaching line, by a pump P20 from a filtrate tank FT_2. According to this embodiment the pump P20 maintains a pressure of about 5 – 6 bar at a first branch portion A1 within the main conduit 1. At this branch position A1 wash liquor and dilution liquor (depending on what kind of wash equipment is being used dilution liquor may possibly be dispensed with. In the case shown in Fig. 2, i.e. using a wash press both liquors have to be supplied, which would not be the case if e.g. a pressure diffuser was used) is taken in L2 to the subsequent wash W_5 of the second bleaching step D_2, from a first branch position A1 in the main conduit. At least a part of the wash filtrate from that wash W_5 of the second bleaching step D_2 is then led in L_2 to a second branch position A2 in the main conduit 1. Wash liquor and dilution liquor is taken via L_3 to the wash W_4 of the first bleaching step D_1, from a third branch position A3 in the main conduit 1, and the filtrate from this wash W_4 is led via L_4 to a fourth branch position A4 of the main conduit. Here, the branch positions A1-A4 connect to the main conduit with the first branch position A1 arranged first, as seen in the direction of flow in the main conduit 1, and the second to fourth branch positions A2-A4 in succession thereafter, such that an open communication is established in the main conduit between the branch positions A1-A4. Accordingly, the main pump P20 pressurises the main liquor within the conduit and establishes a basic flow in the main conduit in a direction reverse to the formed flow of cellulose pulp in the bleaching line. Thanks to the pressurisation within the main conduit 1 there is no need to use an additional pump to supply wash liquor via each respective branch line supplying each respective wash press, see for example L_1 that supplies W_5 positioned finally in the bleach line. This principle applies to all supply lines L_3, L_5 and L_7, that are connected to the main line 1. However, for the return lines, L_2, L_4 and L_6, there is a need for a pump P21', P22', P23', to be able to achieve sufficient pressure to get it in to the main line again.

By way of example it may be assumed that about 10 – 12 m^3/h is added through each supply line, L_1, L_3, L_5, L_7 to each wash apparatus W_5, W_4, W_3, W_1. Normally about 1 – 2 m^3 of this amount is supplied to the wash press for the actual washing through the upper line, whereas about 9 – 10 m^3 is supplied as dilution liquor directly after the wash press W_5.

Due to addition of chemicals in the prior bleaching step D_2 and also some fiberlosses, the flow that is taken from the wash apparatus W_5 in return through line L_2 back to the main conduit 1 is somewhat larger than the amount that is supplied through L_1. Accordingly there will be a subsequent addition of liquid flowing in the main conduit in

its downstream direction. As is evident some of the filtrate from the final wash apparatus W_5 will be added into the supply line L_3 to the second last wash apparatus W_4. As a consequence of the subsequent addition of liquid/chemicals/fibres the flow adjacent the end of the main conduit will be approximately about 1 - 2m^3/h more than is being added at the inlet. Since about 10 – 12 m^3/h is also supplied through the supply line L_7 at the branch point A7 at the downstream end 10, there will be a continuous flow of liquid out from the main conduit 1, at the end outlet 10 thereof amounting to about 0,1 – 2 m^3/h (during operation). The skilled person realises that this example does not limits the scope of the invention, but knows that there are many variables, e.g. kind of wash equipment, production level, kind of bleaching, kind of fibres, etc., that will influence the amount/flow of bleed out.

In Fig. 3 there is shown a further embodiment according to the invention, wherein a low pressure main conduit 1 is being used (merely a portion of the bleach line is shown since the process is the same as shown in Fig. 2. Accordingly it is evident that the same principles as shown for the upstream portion of the main conduit shown in Fig. 3 also applies for the downstream portion). In such an embodiment a pressure of about 1 – 2 bar is maintained within the main conduit 1. As can been seen in Fig. 3 there is therefore a need to use pumps P21, P22, to pressurise the wash liquid that has to be supplied to the wash apparatus through its respective line L_1A, L_3A, etc. However, since the dilution liquid is supplied at an atmospheric addition point, there is no need for using a pump for the supply line L_1B and L_3B for that liquid. Accordingly there is arranged a separate branch position A1', A3' for each of those supply lines L_1B, L_3B. Moreover, it is shown that each standpipe SP9, SP7 directly subsequent to a bleach tower is supplied via its line L_3C, L_4C without the need for a pump. Also in this embodiment, however a pump P21', P22', is needed to pressurise the filtrate back into the main conduit 1. Furthermore, there is shown a modification for achieving the desired pressure in the main conduit, i.e. by replacing the pump with a high tower FT2 and level control LC that controls the pressure by regulating the out flow from the outlet (10, not shown) and/or the inflow from L0 to keep the level within the tower FT2 at a desired level. In all other aspects this embodiment is similar to the function as described in relation to Fig. 2. However, it should be understood that the invention may very well be used merely for two bleach steps, e.g. D1 and D2 as shown in Fig. 3.

In Fig. 4 there is schematically shown a part of a bleach line as in Fig. 3, wherein it is presented that filtrate tanks FT3 may be used within a bleach line according to the invention. Moreover it is also shown that a pressure buffer tank FT4 may be used in

order to balance the pressure within the main conduit 1. It is evident that a number of filtrate tanks may be used and that they may be of comparatively limited size, e.g. less than $1m^3$, possibly about 500 litre. As is disclosed the pump P21' may normally not be dispensed with, since the tank FT_3 is preferably positioned at a relatively low level and is preferably not a pressure vessel. It is also shown that in many cases a further pump P21'' is used to supply the filtrate from the wash W_5 to the tank FT_3.

It is evident that a further main conduit 1' may suitably be used for bleaching steps of different alkalinity (above or below pH7). Hence, then one main conduit,(e.g. as in Fig. 2) is used for a number of acidic steps and another main conduit is used for a number of alkaline steps (the latter not shown).

It is understood that (as shown in Fig. 2) at least one additional bleaching step D_0 may be provided before the first and second bleaching steps D_1 and D_2, respectively, as seen in the flow direction of the cellulose pulp, after which additional bleaching step D_0 there is a wash apparatus W_2 for the pulp. Then wash liquor and dilution liquor is taken to the subsequent wash W_2 of the additional bleaching step, from a fifth branch position A5 in the main conduit 1. At least a part of the wash filtrate from the subsequent wash W_2 of the additional bleaching step is led to a sixth branch position A6 into the main conduit. The branch positions connect to the main conduit with the fifth branch position A5 arranged after the fourth branch position A4, as seen in the direction of flow in the main conduit 1, and the sixth branch position A6 in succession thereafter, an open communication being established in the main conduit between the branch positions A1-A6.

An alkaline extraction step, EOP or alternatively an EO step without peroxide charge, in a *per se* conventional manner, is arranged after the additional bleaching step D_0 and before the first bleaching step D_1, as seen in the direction of flow of the cellulose pulp through the bleaching line, and a wash apparatus W_3 is arranged after the extraction step EOP. The wash filtrate from the subsequent wash W_3 of the extraction step can be collected in a filtrate tank FT_1 and is suitably used as dilution liquor before the extraction step and a part of the wash filtrate can if needed be drawn off from the bleaching line, to sewage 11, or be led forward to an oxygen delignification step. As shown in Fig. 2, the cellulose pulp is washed in a wash apparatus W_1 before the additional bleaching step D_0, (as seen in the direction of flow of the cellulose pulp through the bleaching line) and dilution liquor is taken via L_7 to this wash apparatus W_1

from a seventh branch position A7 in the main conduit. The wash liquor to this wash W_1 is taken from a separate line L_0 as fresh wash liquor.

According to the shown embodiment, at least chlorine dioxide, or some other bleaching chemical that is compatible throughout the bleaching steps, is used as active bleaching agent in the bleaching steps D_0, D_1 and D_2, which chlorine dioxide is added to the pulp before the respective bleaching step in a blending apparatus M1, M3 and M4, respectively.

At the downstream end of the main conduit 1, where the outlet 10 is provided, from which wash liquor and filtrate is drawn off there is arranged some kind of control device. Preferably, the outlet is controlled by a flow controlling control valve FC, which control valve can establish a certain basic flow and/or a desired bleed-off level of filtrate, during normal operation. The pump P20 is suitable controlled by a pressure regulator PC, enabling feed-back control of the main pump device P20 in order to secure the desired predetermined pressure and/or flow throughout the entire main conduit 1. Suitably, the flow controlling valve can establish a desired flow to the outlet 10 as long as the pressure in the main conduit can be maintained. In an alternative embodiment, the flow controlling valve FC may be a fixed or variable throttle valve with a high pressure drop over the valve.

According to the invention a bleaching line is provided for the bleaching of cellulose pulp, having at least two bleaching steps comprising a first and a second bleaching step D_1 and D_2, respectively, as seen in the flow direction of the cellulose pulp, which bleaching steps have wash apparatuses W_4 and W_5 for the pulp arranged after the first and the second bleaching step, respectively, and in which wash liquor and where appropriate dilution liquor is led in principle in counter-current to the pulp flow through the wash apparatuses in the bleach line.

The bleaching line preferably also includes at least one additional bleaching step D_0, which is arranged before the first and second bleaching steps D_1 and D_2, as seen in the direction of flow of the cellulose pulp. After this additional bleaching step D_0, a wash apparatus W_2 for the pulp is arranged. At least one liquor of wash liquor and dilution liquor is taken to the subsequent wash W_2 of the additional bleaching step, from a fifth branch position A5 in the main conduit 1 and at least a part of the wash filtrate from the subsequent wash of the additional bleaching step is led to a sixth branch position A6 in the main conduit 1. The branch positions A5-A6 connect to the main conduit 1 with the

fifth branch position A5 arranged after the fourth branch position A4, as seen in the direction of flow in the main conduit, and the sixth branch position A6 in succession thereafter, an open communication being established in the main conduit between the branch positions A1-A6.

An extraction step may be arranged in the shown bleaching line, preferably of EOP or EO type, which is arranged after the additional bleaching step D_0 and before the first bleaching step D_1, as seen in the direction of flow of the cellulose pulp through the bleaching line, and a wash apparatus W_3 is arranged after the extraction step. The wash filtrate from the subsequent wash W_3 of the extraction step is led to a filtrate tank FT_1, via a conduit, and filtrate from the filtrate tank is, at least partly, led as dilution liquor after the wash step W_2 subsequent to the additional bleaching step D_0, via pump P30 and conduits, and a part of this wash filtrate is when needed drawn off from the process, preferably via an outlet from the filtrate tank FT_1. As shown in the figure, a part of the liquor in the filtrate tank may also be used as dilution liquor in the chute after the EOP reactor.

In the bleaching line, cellulose pulp is suitably washed in a wash apparatus W_1 before the additional bleaching step D_0, as seen in the direction of flow of the cellulose pulp through the bleaching line, and to this wash apparatus W_1 at least one liquor of wash liquor and dilution liquor is led from a seventh branch position A7 in the main conduit 1 to the wash apparatus W_1, via a pump device P24 and associated tubing. If the pulp in the storage tower ST is acidic, both wash and dilution liquor in and after the wash W_1, respectively, can be taken from the main conduit. But if the pulp in the storage tower is alkaline, a cleaner alkaline filtrate or a clean filtrate is used as wash liquor in the wash apparatus W_1, where the use of a clean filtrate is shown in Fig. 2.

In the bleaching steps D_0, D_1, D_2 of the bleaching line, e.g. chlorine dioxide is charged as active bleaching agent or some other bleaching chemical that is compatible throughout the bleaching steps, such as a chelating agent, a pH adjuster or some additional bleaching chemical, which chlorine dioxide or bleaching chemical is added to the pulp before the respective bleaching step in a blending apparatus M1, M3 and M4, respectively.

At the end of the main conduit 1, as seen after the branch points A1-A7, an outlet 10 is provided, from which wash liquor and filtrate can be drawn off from the main conduit.

Suitably, the outlet 10 is controlled as is described above, by a pressure and/or flow controlling control valve PC and/or FC.

The invention can be varied in a number of ways, within the scope of the claims. The bleaching steps that in their subsequent wash apparatuses have a joint main conduit that receives wash filtrate and dilution and/or wash liquor may, for example, all be of alkaline type or the bleaching chemicals in question may be compatible/blendable. In multi-stage bleaching sequences, a main conduit may be used for the alkaline filtrate from two or more alkaline steps and another main conduit may be used for the acidic filtrate from two or more acidic steps.

In the embodiment shown in Fig. 2, the pumps P21-P24 are placed in the feed conduits from the main conduit. In an alternative embodiment, powerful pumps may be provided in the return conduits that connect to the branch points A2, A4 and A6, respectively, which in such case, together with the main pump P20, pressurise the entire main conduit. With a pressure in the main conduit established at 4 bar, pumps in the feed conduits for dilution and/or wash liquor can normally be eliminated. The supply of dilution liquor after wash normally requires a very low pressure of about 1 bar, why a throttle is required for such dilution liquor supply. Normally, the dilution liquor is supplied to an atmospheric dilution screw in which fluffed-up pulp of high consistency, about 30 %, is blended with dilution liquor to a consistency suitable for subsequent pumping. Therefore, there is a low pressure need on the liquor supply.
In another, alternative embodiment, a basic pressure of about 1 bar may be established in the main conduit, which is enough to feed dilution water, but in which a supplying pump is provided in the feed conduit for the wash liquor.
Normally, wash liquor is added in a converging wash slot in a wash press at a higher pressure and normally, a wash liquor pressure of at least 2 - 4 bar is required in this position.

As an additional precautionary measure, a check valve may be provided between the branch positions for filtrate recycling to the main conduit and feeding of dilution and/or wash liquor to the wash apparatus in question, especially if the branch positions of construction reasons are close to each other. It is preferred that an open communication is established between all branch points in the main conduit, as seen in the direction from the first end of the main conduit, with the filtrate tank FT2, to the second end of the main conduit, with the outlet 10, but this does not eliminate that valves may be positioned within the main conduit 1.

Other wash apparatuses than wash presses may of course be used. At less heavy requirements on chemical carry-over to the subsequent bleaching step, ordinary filters or simple presses (without washing) may of course be used, in which the filtrate from the filter or the simple press is led to the main conduit and optional dilution liquor before the filter or the press is taken from the main conduit. Also, wash presses such as a filter or a simple press without wash, may be connected to a joint main conduit.

The skilled person further realises that the at least two bleach steps being connected to the main conduit 1 may have one or more non-connected bleach steps, belong in to the same bleach line, in intermediate position/s between them.

It is also evident that auxiliary equipment, e.g. filtrate tank/s, valves, may be used together with the invention, in certain applications, despite the fact that such equipment mostly in considered as superfluors if the invention is used in an optimized manner. Moreover, it is evident that despite the fact that an optimised embodiment of the invention implies open communication within the whole main conduit, there may be situations/applications where a part or parts of the main conduit (intermittently or temporarily) may be cut off from that communication, e.g. by means of a valve/s. Finally it is understood that the extension of the main conduit may vary, e.g. following a straight line and/or being curved and/or having several bends (e.g. 90°), etc. to fit different needs at different cites, depending on the position of items in the bleach line.

It is also evident for the skilled person that the pressurisation at different locations may be achieved by other means than a pump, e.g. instead of pump P20 a tower or the positioning of the main conduit high up may be used to apply the desired pressure (static pressure).